



Research article

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A new species of *Fidelia* Friese, 1899 (Hymenoptera, Megachilidae), with a key to the species of the genus

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Abstract. A new species of *Fidelia* Friese, 1899 is described from southern Africa: *Fidelia* (*Fideliopsis*) *whiteheadi* Litman & Kuhlmann sp. nov. Diagnostic characters are provided to distinguish this species from others in the genus, particularly from the closely related *F. hessei*; an updated description for *Fidelia hessei* is also given. The host plant preferences and seasonal activity of *F. whiteheadi* Litman & Kuhlmann sp. nov. and *F. hessei* are discussed. Finally, a revised, illustrated key to species of the genus *Fidelia* is presented.

Keywords. Bees, *Fidelia whiteheadi* sp. nov., South Africa, Namibia, pollinator.

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Introduction

The twelve members of the genus *Fidelia* Friese, 1899 are solitary, ground-nesting bees. A single species is known from the xeric regions of the Atlas Mountains in Morocco (Warncke 1980; Whitehead & Eardley 2003). The remaining eleven species are distributed throughout the winter and summer rainfall areas of western and northwestern South Africa, as well as the deserts of Namibia; some observations have also been made in Botswana.

Members of *Fidelia* are robust bees, ranging in size from approximately 7.5 to 20.0 mm (Whitehead & Eardley 2003). Their pilosity may be white through yellow to orange, while the integument is mostly brown to black, although also yellow on the clypeus, mandibles, labrum, and legs of some species. All females and some males exhibit a pygidial plate, which is typically black but yellow in some species. The male seventh tergum has either a simple or bifid apex bordered by lateral spines. Females have a metasomal scopa, as well as a brush of long dense hairs on their hind basitarsi. The female hind basitarsus itself is flattened and paddle-like and is used in nest excavation (Rozen 1977).

The genus *Fidelia* was originally described by Friese in an 1899 monograph (Friese 1899), while the closely related genus *Parafidelia* Brauns, 1926 was later described by Brauns (1926). Michener (2000) synonymized *Fidelia* and *Parafidelia* and proposed *Parafidelia* as a subgenus of *Fidelia*. He also described a new subgenus, *Fidelia (Fideliana)* Michener, 2000, thus dividing *Fidelia* into three subgenera (*Fidelia*, *Fideliana* and *Parafidelia*). Engel (2002) later removed two species from *Fidelia (Parafidelia)* and placed them in a new genus, *Fideliopsis* Engel, 2002; Whitehead & Eardley (2003), however, considered *Fideliopsis* as a subgenus of *Fidelia*, as did Michener (2007). The genus *Fidelia* is thus currently divided into four subgenera, *Fidelia* (three species), *Fideliana* (two species), *Parafidelia* (two species) and *Fideliopsis* (five species) (Michener 2007).

Extensive host plant records for the genus *Fidelia* were reported in Whitehead & Eardley (2003). Although the records listed in Whitehead & Eardley (2003) do not distinguish between floral visits for pollen and visits for nectar, the ensemble of these records suggest that most fidelines are oligolectic: *Fidelia fasciata* Whitehead & Eardley, 2003 and *F. hessei* Whitehead & Eardley, 2003 on various species of *Grielum* and *Neuradopsis* sp. (Neuradaceae); *F. major* Friese, 1911 on *Grielum humifusum* Thunb. and *Grielum* sp.; *F. braunsiana* Friese, 1905 on *Berkheya* spp. (Asteraceae); *F. pallidula* (Cockerell, 1935) on *Sisyndite sparteae* E.Mey. ex Sond. and *Sisyndite* sp. (Zygophyllaceae); *F. ulrikei* Warncke, 1980 on *Convolvulus trabutianus* Schweinf. & Muschl. (Convolvulaceae); and *F. villosa* Brauns, 1902 on various genera of Aizoaceae. *F. kobrowi* Brauns, 1905 and *F. paradoxa* Friese, 1899 have been collected on Aizoaceae and Asteraceae but most records are on Aizoaceae; these bees are either oligolectic on Aizoaceae or polylectic with a strong preference for Aizoaceae. *Fidelia ornata* (Cockerell, 1932) is likely oligolectic on Aizoaceae (most visitation records are for *Tribulocarpus* sp.) (Whitehead & Eardley 2003), although other hosts are possible: Whitehead & Eardley (2003) list a single visitation record for *Tribulus* sp. (Zygophyllaceae). While nearly all floral records for *F. friesei* (Brauns, 1926) are for *Sesamum triphyllum* Welw. ex Asch. and *Sesamum* sp. (Pedaliaceae), records for *Salvia* sp. (Lamiaceae) and *Crotalaria* sp. (Fabaceae) have also been reported (Whitehead & Eardley 2003).

Members of *Fidelia* exhibit an unusual combination of morphological characters, including three submarginal wing cells and a metasomal scopa. They also exhibit peculiar nesting behavior: they build unlined nests, a behavior rarely seen in bees. A recently published molecular phylogeny identified the genus *Fidelia* as one of the earliest branching lineages of the family Megachilidae (Litman *et al.* 2011). Members of the genus *Fidelia* are thus phylogenetically significant bees and the discovery of a new species is an important finding that justifies the description of a single new species in the context of a recent revision of the genus (Whitehead & Eardley 2003).

Collecting trips undertaken by J.R.L. and C.D.E. to the Northern Cape Province in October 2008 and February 2009 yielded two series of specimens that both key out to *Fidelia (Fideliopsis) hessei* in Whitehead & Eardley's (2003) key. Upon close inspection, however, both series of specimens exhibit distinctly different features. A thorough re-examination of the type material used in the description of *F. hessei* Whitehead & Eardley, 2003 indeed revealed two distinct but apparently closely related species. We describe the new species here as *Fidelia (Fideliopsis) whiteheadi* Litman & Kuhlmann sp. nov., redescribe its close relative *F. (F.) hessei* and provide a revised key to the species of *Fidelia*.

Materials and methods

The majority of the type material used in this description is deposited in the Iziko South African Museum in Cape Town, South Africa; a limited number of specimens are also deposited in the Natural History Museum of Neuchâtel (Neuchâtel, Switzerland), the Oberösterreichs Landesmuseum, Biologiezentrum (Linz, Austria) and in the Litman-Praz Collection (Neuchâtel, Switzerland). Morphological terminology is taken from Michener (2007).

Abbreviations

We use the following abbreviations:

BL = Body length (measured between anterior margin of clypeus and apex of metasoma)

IW = Intertegular width (width of body measured between wing bases)

T = Metasomal tergum (when followed by a number, refers to number of tergum; for example, T1 refers to the first metasomal tergum)

S = Metasomal sternum (when followed by a number, refers to number of sternum; for example, S1 refers to the first metasomal sternum)

The following abbreviations are used for collections and institutions:

SAM = Iziko South African Museum, Cape Town, South Africa

MHNN = Natural History Museum of Neuchâtel, Neuchâtel, Switzerland

OÖLM = Oberösterreichs Landesmuseum, Biologiezentrum, Linz, Austria

LPC = Litman-Praz Collection, Neuchâtel, Switzerland

CSCF = Centre Suisse de Cartographie de la Faune, Neuchâtel, Switzerland

The following abbreviations are used in the list of material examined:

NCP = Northern Cape Province, South Africa

WCP = Western Cape Province, South Africa

Photographs were taken with a Dino-Lite AM413T digital microscope at the Natural History Museum of London, as well as with a VHX-1000 Keyence digital microscope co-hosted by the MHNN and the CSCF.

Results

Class Hexapoda Blainville, 1816
Order Hymenoptera Linnaeus, 1758
Superfamily Apoidea Latreille, 1802
Epifamily Anthophila Latreille, 1804
Family Megachilidae Latreille, 1802
Genus *Fidelia* Friese, 1899
Subgenus *Fideliopsis* Engel, 2002

***Fidelia (Fideliopsis) whiteheadi* Litman & Kuhlmann sp. nov.**
[urn:lsid:zoobank.org:act:B88E995E-1B96-4DD5-BC76-9E819BE92A4B](https://zoobank.org/urn:lsid:zoobank.org:act:B88E995E-1B96-4DD5-BC76-9E819BE92A4B)

Figs 1A, C, E, 2A, C, 3A, C, E

Diagnosis

Fidelia (Fideliopsis) whiteheadi Litman & Kuhlmann sp. nov. can be distinguished from members of the subgenera *Fidelia* and *Fideliana* by the length of the marginal cell of its forewing, which is approximately 0.75× the distance between the apex of the marginal cell and the distal edge of the wing (length of marginal cell less than half this distance in the subgenera *Fidelia* and *Fideliana*).

F. whiteheadi Litman & Kuhlmann sp. nov. can be further distinguished from the two members of the subgenus *Parafidelia*. It differs from *Fidelia* (*Parafidelia*) *friesei* by the gentle curve of the female mid-tibial spur (strongly sickle-shaped in female *F. friesei*) and by the unswollen forefemur and forebasitarsus of the male (swollen in *F. friesei*) and from *F. pallidula* by the presence of two equal-sized mandibular teeth in females (apical and preapical tooth present in female *F. pallidula*) and by the bifid, triangular T7 of the male (T7 long, parallel-sided and rounded at the apex in *F. pallidula*). From other members of the subgenus *Fidelia* (*Fideliopsis*) (except *F. hessei*), *F. whiteheadi* Litman & Kuhlmann sp. nov. can be distinguished by the unmodified forebasitarsus of the male (modified in other members of *F. (Fideliopsis)*), the yellow, convex-sided pygidial plate of the female (black or brown and concave-sided in other members of *F. (Fideliopsis)*) and the shape of the male S7 and S8 (see below for details).

Fidelia whiteheadi Litman & Kuhlmann sp. nov. is morphologically most similar to *F. hessei*. *F. whiteheadi* Litman & Kuhlmann sp. nov. is smaller and less broad than *F. hessei*. Both females and males of *Fidelia whiteheadi* Litman & Kuhlmann sp. nov. exhibit relatively short pilosity on the thorax, metasoma and legs (Fig. 1A). In *F. hessei*, pilosity is comparatively longer (Fig. 1B). In female *F. whiteheadi* Litman & Kuhlmann sp. nov., hairs on the forebasitarsus are brushy and the tips of hairs are often bent at a sharp angle (Fig. 1C); in comparison, the hairs on the forebasitarsus of *F. hessei* are shaggy and unmodified (Fig. 1D). The posterior margin of the pygidial plate in *F. whiteheadi* Litman & Kuhlmann sp. nov. is evenly rounded and nearly triangular (Fig. 1E); in *F. hessei*, it is slightly flattened apically (Fig. 1F).

A triangular protuberance at the base of the male T7 in *F. whiteheadi* Litman & Kuhlmann sp. nov. is strongly elevated; when examined in profile, the posterior margin of the protuberance meets the surface of the tergum at a nearly 90 degree angle (Fig. 2A). In *F. hessei*, the protuberance at the base of T7 is less pronounced and the angle where the protuberance meets the surface of T7 is less sharp (Fig. 2B). A half-moon shaped protuberance on the male S2 is present in *F. whiteheadi* Litman & Kuhlmann sp. nov. but is only slightly elevated and often completely hidden by the pilosity of S2; the length of the protuberance is about a quarter of the length of the sternum (Fig. 2C). In *F. hessei*, the half-moon shaped protuberance is more strongly elevated and is usually easily visible despite the surrounding pilosity; the length of the protuberance is about one-third of the length of the sternum (Fig. 2D).

The most striking differences between *F. whiteheadi* Litman & Kuhlmann sp. nov. and *F. hessei* are found in the male hidden sterna and genitalia. In both *F. whiteheadi* Litman & Kuhlmann sp. nov. and *F. hessei*, the male S7 bears two apicolateral processes but in *F. whiteheadi* Litman & Kuhlmann sp. nov. the processes of S7 are relatively narrower, more weakly sclerotized, less hairy and shorter (Fig. 3A) than those of *F. hessei* (Fig. 3B). The male S8 of *F. whiteheadi* Litman & Kuhlmann sp. nov. narrows sharply in the posterior third (Fig. 3C), while that of *F. hessei* narrows more gradually (Fig. 3D). The gonostylus of *F. whiteheadi* Litman & Kuhlmann sp. nov. is distinctly narrower and the basal outer edge more rounded (Fig. 3E) than in *F. hessei* (Fig. 3F).

Etymology

This species is named for the late Vincent Booth Whitehead (1921–2005), whose extensive collection of fideleine bees deposited at the Iziko South African Museum in Cape Town, South Africa provided the majority of the material for this species description.

Type material

Holotype

NAMIBIA: ♂, Koës, Katzies, 09 Mar. 1982, V.B. Whitehead (SAM), SAM-HYM-B001841.

Paratypes (all specimens deposited in SAM unless otherwise noted)

NAMIBIA: 1 ♂, 10 km N of Kalkrand, 24.03° S, 17.57° E, 07 Mar. 1980; 2 ♀♀, 15 km S of Stampriet, 24.42° S, 18.48° E, 13 Apr. 1980; 1 ♀, 1 ♂, 16 km S of Stampriet, 24.42° S, 18.48° E, 8 Feb. 1984; 3 ♀♀, 1 ♂, 18 km S of Aroab, 26.93° S, 19.55° E, 11 Apr. 1980; 3 ♀♀, 2 ♂♂, 25 km N of Koës, 25.75° S, 19.25° E, 27 Apr. 1981; 1 ♂, 25 km S of Stampriet, 24.25° S, 18.53° E, 13 Apr. 1980; 5 ♀♀, 30 km N of Koës, 25.72° S, 19.27° E, 12 Apr. 1980; 2 ♀♀, 30 km S of Gochas, 25.05° S, 18.98° E, 12 Apr. 1980; 1 ♀, 1 ♂, 30 km S of Leonardville, 23.77° S, 18.87° E, 15 Apr. 1980; 8 ♀♀, 4 ♂♂, 31 km S of Leonardville, 23.77° S, 18.87° E, 15 Apr. 1981; 3 ♀♀, 32 km S of Leonardville, 23.77° S, 18.87° E, 18 Mar. 1979; 4 ♀♀, 33 km E of Gochas, 24.75° S, 19.12° E, 13 Apr. 1980; 3 ♀♀, 9 ♂♂, 33 km NW of Vorstershoop, 25.63° S, 22.92° E, 29 Feb. 1980; 3 ♀♀, 34 km N of Koës, 25.7° S, 19.32° E, 12 Apr. 1980; 1 ♀, 4 km N of Leonardville, 23.45° S, 18.77° E, 9 Feb. 1984; 1 ♀, 4 km N of Leonardville, 23.45° S, 18.77° E, 10 Feb. 1984; 1 ♂, 5 km W of Aus, 26.65° S, 16.23° E, 6 Oct. 1982; 3 ♀♀, 1 ♂, 5 km W of Klinghardt Mts, 27.38° S, 15.63° E, 4 Oct. 1982; 2 ♀♀, 5 km W of Leonardville, Farm 206, 23.57° S, 18.32° E, 15 Oct. 1980; 6 ♀♀, 51 km S of Aroab, 27.15° S, 19.48° E, 11 Apr. 1980; 5 ♀♀, 3 ♂♂, 6 km NW of Leonardville, 23.47° S, 18.88° E, 15 Apr. 1981; 1 ♀, 6 km W of Leonardville, 23.48° S, 18.73° E, 15 Apr. 1980; 1 ♀, 60 km S of Grünau, 28.15° S, 18.05° E, 17 Apr. 1980; 6 ♀♀, 3 ♂♂, 7 km NW of Leonardville, 23.48° S, 18.72° E, 26 Apr. 1981; 3 ♀♀, Cucumis, 24.01° S, 18.42° E, 11 Feb. 1984; 1 ♀, 3 ♂♂, Diamond Area No. 1, Klinghardt Mts, Spitzkuppe Sud, 26.5° S, 15.5° E, 19 Oct. 1974; 6 ♀♀, Diamond Area No. 1, Klinghardt Mts, Spitzkuppe Sud, 26.5° S, 15.5° E, 21 Oct. 1974; 4 ♀♀, 1 ♂, Grillental, 27.13° S, 15.38° E, 29 Sep. 1982; 6 ♀♀, 11 ♂♂, Klinghardt Mts, 27.38° S, 15.88° E, 1 Oct. 1982; 1 ♀, 2 ♂♂, Klinghardt Mts, 27.38° S, 15.88° E, 2 Oct. 1982; 3 ♀♀, 2 ♂♂, Koës, Katzies, 9 Mar. 1982; 1 ♂, Luderitz, Obib Dunes, 28.17° S, 16.8° E, 17 Sep. 1973; 1 ♀, Obib, 28.08° S, 16.75° E, 29 Oct. 1977; 1 ♀, 3 ♂♂, Stampriet 132, 24.38° S, 18.38° E, 8 Mar. 1982.

SOUTH AFRICA: 1 ♂, NCP, 11 km N of McCarthy's Rust, 26.2° S, 22.57° E, 1 Mar. 1980; 4 ♀♀, NCP, 14 km S of Kenhardt, 29.27° S, 21.04° E, 27 Nov. 1981; 1 ♀, NCP, 15 km N of Noenieput, 27.38° S, 20.1° E, 7 Feb. 1984; 2 ♀♀, 1 ♂, NCP, 20 km NW of Kenhardt on Kakamas Rd, 29.14° S, 21.01° E, 27 Nov. 1981; 9 ♀♀, NCP, 40 km N of Kakamas, Biesiepoort, 28.43° S, 20.6° E, 29 Apr. 1981; 1 ♀, NCP, 40 km SW of Kakamas, 29.05° S, 20.27° E, 6 Feb. 1984; 3 ♀♀, NCP, 40 km W of Van Zylsrus, 27.05° S, 21.67° E, 3 Mar. 1980; 1 ♀, NCP, 50 km S of Vioolsdrift, 29.17° S, 17.83° E, 20 Oct. 1980; 2 ♀♀, NCP, Brekerie Dunes, Vanwyksvlei, 3 May 1985; 6 ♀♀, 2 ♂♂, NCP, Brekerie Dunes, Vanwyksvlei, 4 May 1985; 4 ♀♀, NCP, Brekerie Dunes, Vanwyksvlei, 5 May 1985; 1 ♀, 3 ♂♂, NCP, Jakkalsputs, 28.67° S, 16.95° E, 8 Oct. 1980; 1 ♂, NCP, Lekkersing, Richtersveld, 29° S, 17.1° E, 25 Sep. 1982; 4 ♀♀, 1 ♂, NCP, Hotazel exit, Rt. 31, 27°12.558' S, 22°57.264' E, 1 Feb. 2009 (2 ♀♀, 1 ♂ LPC; 2 ♀♀ MHNN); 3 ♀♀, NCP, 2 km NW of Hotazel, Rt. 31, 27°11.855' S, 22°55.909' E, 3 Feb. 2009 (1 ♀ LPC; 2 ♀♀ OÖLM).

Description**Female**

MEASUREMENTS. BL= 10–11 mm; Iw = 3 mm.

HEAD. Broader than long. Integument black. Clypeus basally black, apically yellow, mandible yellow with two red-brown teeth, upper tooth longer than lower. Head covered by dense white pilosity. Pilosity near vertex either white or pale yellow. Clypeus convex, flattened medially. Clypeus densely, minutely, superficially punctate apically; punctation gradually becoming larger and sparser basally, with spaces between punctures reaching the diameter of one-half a puncture, rarely one puncture, at clypeal base. Antennal scape and pedicel dark red-brown to black. Flagellum dorsally red-brown to pale yellow, ventrally most often yellow, although occasionally also yellow-red.

MESOSOMA. Integument dark red-brown to black. Mesosomal disc very densely punctate, almost no spaces between punctures. Pilosity white to pale yellow, dense, generally short but often longer on mesopleuron and scutellum. Wings colorless, venation light brown, papillate beyond veins. Integument of legs red-brown, slightly lighter at apex of foretibia and forebasitarsus. Integument of hind femur

lighter in color than that of fore and mid femur. Foretrochanter, forefemur, most of foretibia covered in white hairs. Apex of foretibia and forebasitarsus covered in shorter, golden hairs. Forebasitarsus with brushy, erect hairs, often bent at a 90 degree angle; length of hairs at posterior base of basitarsus shorter than width of basitarsus at its base (Fig. 1C). Mid and hind legs covered in long, dense white hairs.

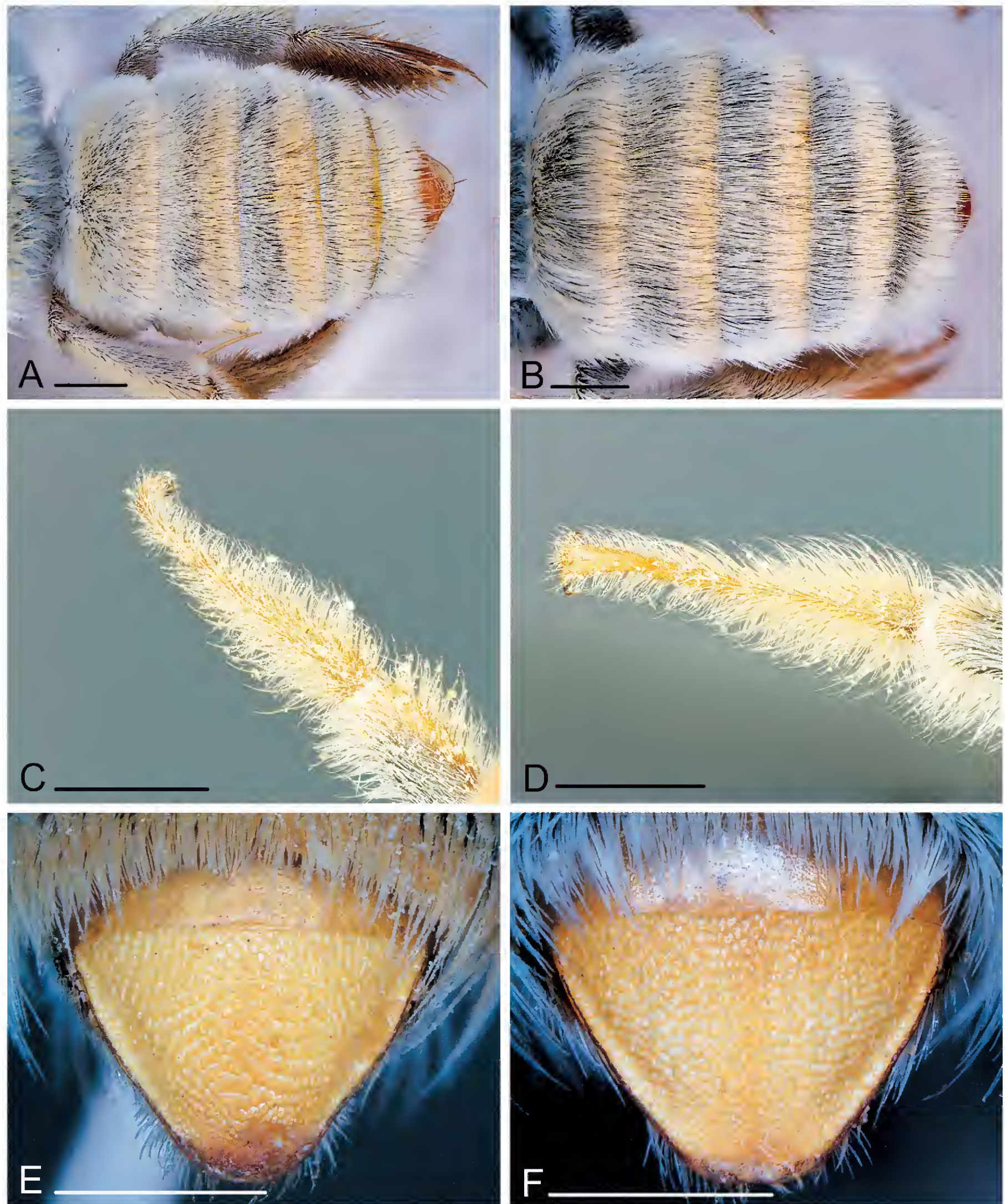


Fig. 1. *Fidelia* spp., ♀♀. **A, C, E.** *Fidelia whiteheadi* Litman & Kuhlmann sp. nov. (paratype). **B, D, F.** *F. hessei* Whitehead & Eardley, 2003. **A–B.** Metasoma. **C–D.** Forebasitarsus. **E–F.** Pygidial plate. Scale bars: 1 mm.

Hind basitarsus with long yellow-brown hairs on dorsal and ventral edges; dorsal hairs longer than ventral hairs.

METASOMA. Integument red-brown to black on tergal discs, tergal margins transparent, light brown to yellow. Pilosity white to yellow. Pilosity on T1 slightly longer than that of T2–T5. Pilosity on discs of T2–T5 nearly uniform in density and length. Pilosity in longer tufts laterally on T1–T5. Pilosity longest on T6, both on tergal disc and laterally. Lateral tufts on T6 seldom reach apex of pygidial plate (Fig. 1A). Outline of pygidial plate evenly rounded in dorsal view, nearly triangular in form. Color of pygidial plate variable, from pale white-yellow to dark yellow (Fig. 1E). Integument of sterna red-brown. Pilosity of metasomal scopa white.

Male

MEASUREMENTS. BL = 9–11 mm; Iw = 2.5 mm.

Same as for female except as follows:

HEAD. Clypeus uniformly dark red-brown. Pilosity on head uniformly white, even on vertex.

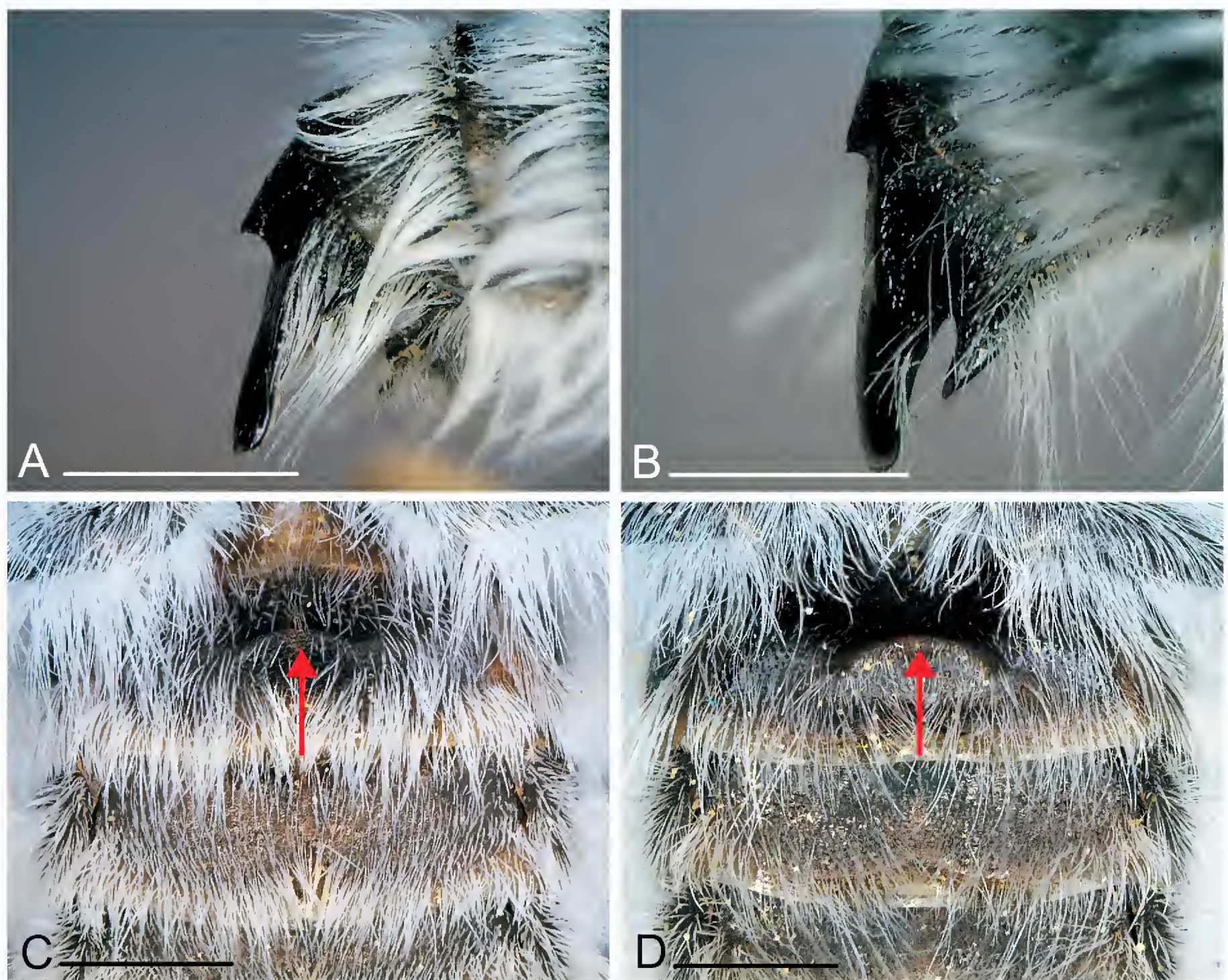


Fig. 2. *Fidelia* spp., ♂♂. **A, C.** *Fidelia whiteheadi* Litman & Kuhlmann sp. nov. (paratype). **B, D.** *F. hessei* Whitehead & Eardley, 2003. **A–B.** Protuberance at base of T7. **C–D.** Protuberance on S2, indicated by red arrow. Scale bars: 1 mm.

MESOSOMA. Pilosity on mesosoma white. Integument of forecoxa, foretrochanter and forefemur dark brown, that of foretibia and foretarsus yellow. Pilosity on forelegs entirely white. Pilosity on forebasitarsus approximately three times as long as width of basitarsus. On mid and hind legs, all segments dark brown except apex of basitarsus and tarsal segments. Pilosity on mid and hind legs white.

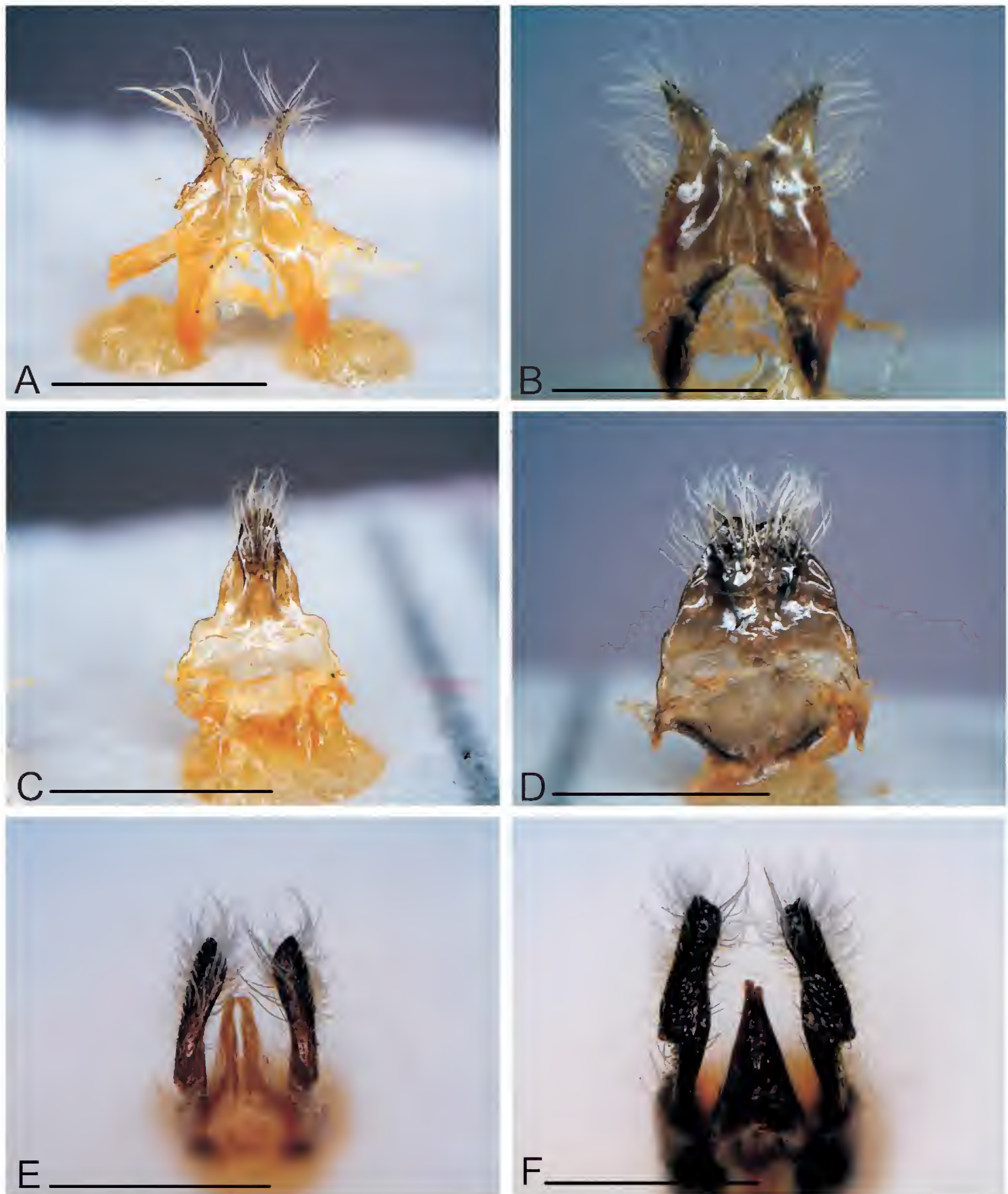


Fig. 3. *Fidelia* spp., ♂♂. **A, C, E.** *Fidelia whiteheadi* Litman & Kuhlmann sp. nov. (paratype). **B, D, F.** *F. hessei* Whitehead & Eardley, 2003. **A–B.** S7. **C–D.** S8. **E–F.** Gonostyli. Scale bars: 1 mm.

METASOMA. Protuberance at base of T7 strongly elevated, making a 90 degree angle with surface of tergum. Half-moon shaped protuberance on S2 weakly elevated, often hidden by pilosity on ventral metasoma (Fig. 2C). S7 with two apicolateral processes; each process narrow, weakly sclerotized and, except at tip of each process, only sparsely hairy (Fig. 3A). Length of each process of S7 approximately two-thirds as long as length of central disc of sternum (Fig. 3A). S8 sharply narrowed in posterior third, such that width of apex approximately one-fifth of width of base of sternum (Fig. 3C). S8 without paraspiculae (Fig. 3C). Gonostylus narrow and, in dorsal view, basal outer edge rounded (Fig. 3E).

General distribution

Winter rainfall area of northwestern South Africa and southwestern Namibia; summer rainfall area of north-central South Africa and southeastern and south-central Namibia (Fig. 4).

Floral hosts

Grielum grandillorum [sic; we interpret this as *Grielum grandiflorum* (L.) Druce], *Grielum sinuatum*, *Grielum* sp., and *Neuradopsis* sp. (Whitehead & Eardley 2003).

Seasonal activity

Two periods of activity a year, one from February to May (in summer rainfall area) and the second from September to November (in winter rainfall area) (Fig. 4).

Remarks

To clearly distinguish *Fidelia* (*Fideliopsis*) *whiteheadi* Litman & Kuhlmann sp. nov. from *Fidelia* (*Fideliopsis*) *hessei*, we also provide a description for the latter.

Fidelia (*Fideliopsis*) *hessei* Whitehead & Eardley, 2003

Figs 1B, D, F, 2B, D, 3B, D, F

Holotype

SOUTH AFRICA: ♂, NCP, 29 km E of Port Nolloth, 29.18° S, 17.09° E, 18 Sep. 1983 (SAM) (as designated by Whitehead & Eardley 2003), SAM-HYM-B001836.

Other material examined (all specimens deposited in SAM unless otherwise noted)

NAMIBIA: 2 ♂♂, Klinghardt Mts, 27.38° S, 15.88° E, 19 Oct. 1974.

SOUTH AFRICA: 2 ♀♀, 5 km S of Ratelfontein, 32.13° S, 18.63° E, 25 Oct. 1978; 3 ♀♀, 1 ♂, NCP, 27 km E of Port Nolloth, 29.3° S, 17.15° E, 18 Sep. 1983; 5 ♂♂, NCP, 27 km E of Port Nolloth, 29.283° S, 17.133° E, 25 Sep. 1982; 1 ♀, NCP, 30 km E of Port Nolloth, 29.3° S, 17.18° E, 2 Oct. 1981; 9 ♀♀, NCP, 36 miles Grass Flats, 29.38° S, 17.38° E, 04 Oct. 1980; 2 ♀♀, 1 ♂, NCP, 38 km N of Concordia, 29.27° S, 18.0° E, 20 Nov. 1980; 1 ♂, NCP, Brandkaros, 28.47° S, 16.68° E, 29 Sep. 1982; 1 ♂, NCP, Grasvlakte, 29.18° S, 17.42° E, 18 Sep. 1983; 3 ♀♀, NCP, Oograbies, 20 km E of Port Nolloth, 29.23° S, 17.13° E, 18 Nov. 1980; 11 ♀♀, 3 ♂♂, NCP, Wallekraal, Namaqualand, 30.38° S, 17.52° E, 1 Oct. 1950; 4 ♀♀, 2 ♂♂, WCP, 10 km N of Graafwater, 32.07° S, 18.6° E, 21 Oct. 1981; 1 ♀, WCP, 10 km N of Leipoldtville, 32.13° S, 18.52° E, 25 Oct. 1978; 1 ♀, WCP, 5 km E of Elands Bay, 32.28° S, 18.35° E, 08 Nov. 1978; 3 ♀♀, 1 ♂, WCP, 7 km N of Leipoldtville, 32.18° S, 18.5° E, 08 Nov. 1978; 1 ♂, WCP, Elands Bay, Baboon Point, 32.32° S, 18.32° E, 13 Nov. 1979; 1 ♂, WCP, Graafwater, 7 km N of Leipoldtville, 32.18° S, 18.5° E, 08 Nov. 1978; 1 ♂, WCP, Paleisheuvel, 32.39° S, 18.43° E, 01 Nov. 2001; 1 ♀, WCP, Paleisheuvel, 32.47° S, 18.72° E, 10 Nov. 1978; 3 ♀♀, 4 ♂♂, WCP, Paleisheuvel, 32.47° S, 18.72° E, 17 Nov. 1978; 3 ♀♀, WCP, Skurfkop station, 31.88° S, 18.63° E, 21 Oct. 1981; 5 ♀♀, 2 ♂♂, WCP, Skurfkop station, 31.88° S, 18.63° E, 25 Oct. 1978; 2 ♂♂, WCP, Skurfkop, 31.95° S, 18.62° E, 10 Nov. 1978; 1 ♀, NCP, 42 km S of Eeksteenfontein, 29°06.869' S, 17°25.694' E, 09 Oct. 2008 (LPC).

Note

The SAM database lists the date of collection for five male *Fidelia hessei* as “1982/04/25”. A close look at the handwritten label on the specimens strongly suggests, however, that the labels do not read “25. iv.1982” but rather “25.ix.1982”. Given the difficulty in reading the labels on these specimens, and given the total absence of other specimens of *F. hessei* during the fall months, we consider these specimens to have been collected in September and not April.

Description

Female

MEASUREMENTS. BL = 11–12 mm; Iw = 4 mm.

HEAD. Broader than long. Integument on head and base of clypeus black. Clypeus apically dark to yellow brown. Clypeus minutely, superficially punctate from base to apex. Mandible yellow with two red teeth, upper tooth longer than lower. Head covered in dense white pilosity. Clypeus convex, flattened medially. Antennal scape and pedicel dark red-brown. Dorsally, antennal flagellum dark red-brown basally, becoming yellow-brown apically. Ventrally, flagellum yellow.

MESOSOMA. Integument black. Mesosomal disc densely, minutely punctate. Pilosity dense, shaggy, white to pale yellow, sometimes longer on mesopleuron and scutellum. Wings colorless to pale yellow, venation light brown, papillate beyond veins.

LEGS. Dark red-brown basally, becoming paler yellow-brown apically. Forecoxa, trochanter and femur covered in white pilosity. Foretibia and foretarsus covered in golden pilosity. Pilosity on forebasitarsus long, shaggy – length of hairs at posterior base of basitarsus approximately twice as long as width of basitarsus at its base (Fig. 1D). Mid and hind coxa, trochanter and femur covered in short white pilosity. Midtibia, midtarsus and hind tibia covered in longer, denser white to white-yellow pilosity. Hind basitarsus with long yellow-brown hairs on dorsal and ventral edges; dorsal hairs longer than ventral.

METASOMA. Integument black on tergal discs, tergal margins transparent, light brown to yellow. Pilosity shaggy white to yellow-white, with pilosity on tergal discs often erect, while pilosity on tergal margins lies flat (Fig. 1B). Longer tufts of hair present laterally on T1–T6, with pilosity on T6 longer, with lateral tufts almost reaching apex of pygidial plate. Outline of pygidial plate triangular, with flattened apex in dorsal view (Fig. 1F). Pygidial plate variable in color, from dark yellow to brown. Integument of sterna red-brown. Hairs on metasomal scopa white.

Male

MEASUREMENTS. BL = 10–12 mm; Iw = 2.5–4 mm.

Same as for female except as follows:

HEAD. Integument on head and clypeus entirely dark brown to black.

MESOSOMA. Pilosity white.

LEGS. Forecoxa, trochanter and femur dark brown. Foretibia and foretarsus yellow. Pilosity on forelegs entirely white. Pilosity on forebasitarsus long at base, approximately four times as long as width of forebasitarsus at its base. Mid and hind legs and all segments dark brown except apex of basitarsus and tarsal segments. Pilosity on mid and hind legs white, except on hind basitarsus, where ventral fringe of hairs is yellow white.

METASOMA. T7 dark brown to black. Protuberance at base of T7 usually weakly elevated, making a shallow angle with respect to surface of tergum. Half-moon shaped protuberance on S2 strongly elevated, usually

visible through pilosity on ventral metasoma. S7 with two apicolateral processes (Fig. 3B); each process broader, more strongly sclerotized, and more densely hairy than in *F. whiteheadi* Litman & Kuhlmann sp. nov. Length of each process on S7 approximately one-half as long as length of central disc of sternum (Fig. 3B). S8 narrows gradually in posterior third, such that width of apex is approximately one-third of width of base of sternum (Fig. 3D). S8 without paraspiculae (Fig. 3D). Gonostylus distinctly broader and basal outer edge more sharply angled (Fig. 3F) than in *F. whiteheadi* Litman & Kuhlmann sp. nov.

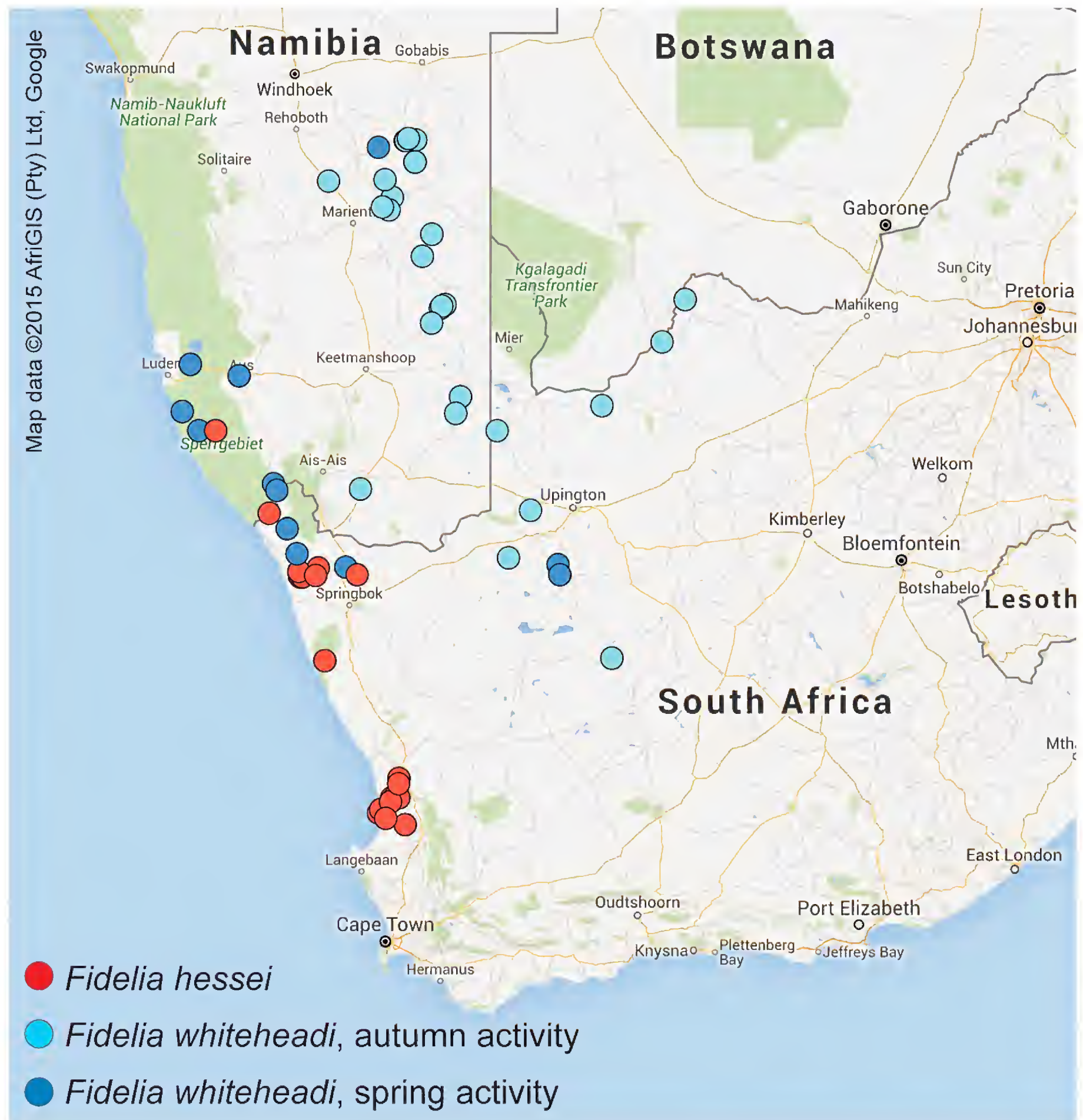


Fig. 4. Distribution map of *Fidelia hessei* Whitehead & Eardley, 2003 (red dots), *Fidelia whiteheadi* Litman & Kuhlmann sp. nov., autumn period of activity (light blue dots) and *Fidelia whiteheadi* Litman & Kuhlmann sp. nov., spring period of activity (dark blue dots). The northernmost occurrence of *F. hessei* shown on the map corresponds to morphologically ambiguous specimens collected in the region around the Klinghardt Mountains of Namibia; the identification of the specimens from this region should be corroborated with DNA data.

General distribution

Winter rainfall area of western and northwestern South Africa (Fig. 4).

Floral hosts

Grielum grandillorum [*sic*; we interpret this as *Grielum grandiflorum*], *Grielum sinuatum*, *Grielum* sp., and *Neuradopsis* sp. (Whitehead & Eardley 2003).

Seasonal activity

One period of activity per year, from September to November.

Key to species of *Fidelia*

(modified from Whitehead & Eardley 2003)

Note: in couplets where color of vestiture is mentioned, color refers to that of freshly eclosed specimens. In older specimens, color of vestiture is often faded compared to that of younger specimens.

1. Marginal cell of forewing shorter than half distance between apex of marginal cell and distal wing edge; female pygidial plate yellow and covering entire dorsal surface of T6; southern Africa and Morocco (*Fidelia sensu stricto* and *Fideliana*) 2
 - Marginal cell of forewing shorter (0.75×) than distance between marginal cell and distal end of forewing; female pygidial plate yellow or black, large but not covering entire dorsal surface of T6, a little vestiture visible on each side of pygidial plate, except *F. hessei* which resembles *Fidelia sensu stricto*; southern Africa (*Parafidelia* and *Fideliopsis*) 6
2. Female clypeus black to mostly black; male with foretibia and forebasitarsus unmodified (*Fideliana*) 3
 - Female clypeus yellow to mostly yellow; male forebasitarsus with distinct groove, foretibia expanded (*Fidelia sensu stricto*) 4
3. Female vestiture mostly orangish and black, T5 black; male mandible with an apical and a sub-apical tooth..... *F. braunsiana* Friese, 1905
 - Female vestiture, including T5, mostly white; male mandible with a single tooth *F. ulrikei* Warncke, 1980
4. Female T5 with orange vestiture; male T7 as in Fig. 5A; male forebasitarsus weakly expanded (Fig. 5B), distinctly less than half as wide as maximum length *F. kobrowi* Brauns, 1905
 - Vestiture on female T5 white to pale yellow; male forebasitarsus greatly expanded, more than half as wide as maximum length 5
5. Distal part of female pygidial plate black; scopa yellowish; male with white vestiture; T7 as in Fig. 5C; male forebasitarsus expanded posteriorly (anterior and posterior edges more or less parallel), as in Fig. 5D *F. villosa* Brauns, 1902
 - Female pygidial plate completely yellow; scopa white; male with white to yellow vestiture; T7 as in Fig. 5E; male forebasitarsus expanded more strongly posteriorly (posterior edge strongly convex), as in Fig. 5F *F. paradoxa* Friese, 1899
6. Female middle tibial spur strongly sickle shaped; hind tibia with black pubescence; male T7 as in Fig. 6A; male forefemur strongly swollen (length double width) and forebasitarsus moderately swollen (0.4× as long as wide) *F. friesei* (Brauns, 1926)

- Female middle tibial spur gently curved; hind tibia with pallid pubescence; male forefemur unmodified (width distinctly less than half length); forebasitarsus unmodified or strongly swollen (0.6–0.7× as long as wide)..... 7

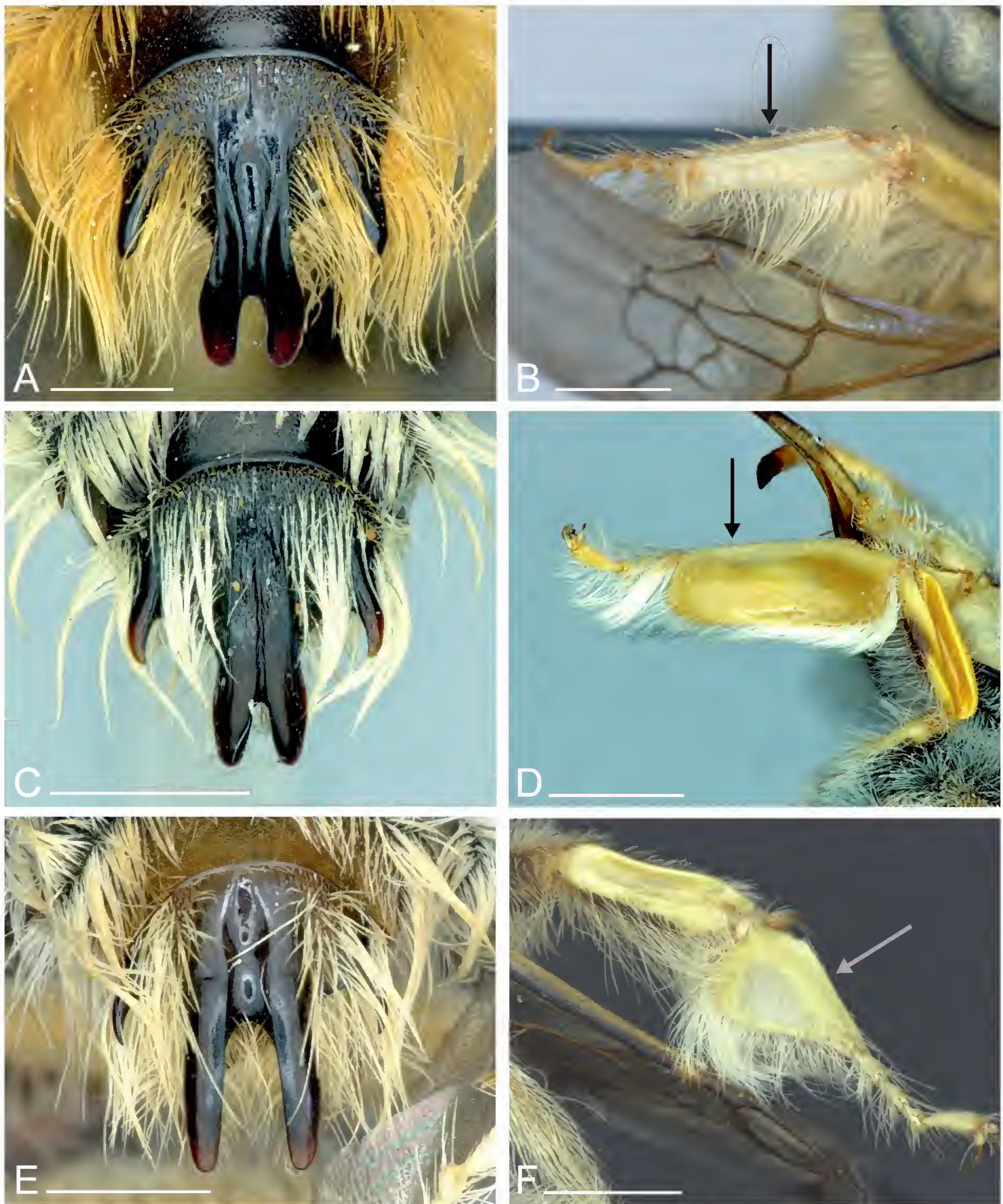


Fig. 5. *Fidelia* spp., ♂♂. **A–B.** *Fidelia kobrowi* Brauns, 1905. **A.** T7. **B.** Forebasitarsus. **C–D.** *F. villosa* authorship?. **C.** T7. **D.** Forebasitarsus. **E–F.** *F. paradoxa* Friese, 1899. **E.** T7. **F.** Forebasitarsus. Scale bars: 1 mm.

7. Female mandible with an apical and a preapical tooth; clypeus and labrum black; male T7 as in Fig. 6B; forebasitarsus unmodified..... *F. pallidula* (Cockerell, 1935)
 – Female mandible with two large, equal-sized teeth; clypeus yellow and labrum at least partly yellow (only ventral half yellow in *F. borearipa* Whitehead & Eardley, 2003); male T7 as in Figs 6C–E, 7A, C; forebasitarsus enlarged, except unmodified in *F. hessei* and moderately enlarged in *F. borearipa* (*Fideliopsis*)..... 8



Fig. 6. *Fidelia* spp., ♂♂. A–E. T7. A. *Fidelia friesei* (Brauns, 1926). B. *F. pallidula* (Cockerell, 1935). C. *F. hessei* Whitehead & Eardley, 2003. D. *F. whiteheadi* Litman & Kuhlmann sp. nov. E. *F. fasciata* Whitehead & Eardley, 2003 (paratype). F. *F. fasciata*, forebasitarsus (paratype). Scale bars: 1 mm.

8. Female pygidial plate yellow and convex laterally, with no T6 vestiture visible on side of pygidial plate in dorsal view; male foretarsus not modified, T7 as in Fig. 6C or 6D 9
 - Female pygidial plate black or brown and concave laterally, with a little T6 vestiture visible on side of pygidial plate in dorsal view; male foretarsus modified..... 10
9. Female pygidial plate with flattened apex (Fig. 1F); pilosity on female forebasitarsus long, shaggy (Fig. 1D); length of apicolateral process of male S7 approximately one-half as long as length of central disc of sternum (Fig. 3B); male S8 narrows gradually in posterior third (Fig. 3D) *F. hessei* Whitehead & Eardley, 2003
 - Female pygidial plate nearly triangular in form (Fig. 1E); pilosity on female forebasitarsus brushy, erect (Fig. 1C); length of apicolateral process on male S7 approximately two-thirds as long as length of central disc of sternum (Fig. 3A); male S8 narrows sharply in posterior third (Fig. 3C) *F. whiteheadi* Litman & Kuhlmann sp. nov.
10. Vestiture on metasomal T2–T5 in female and T3–T6 in male black anteriorly, white posteriorly; female hind tibia white dorsally; male T7 as in Fig. 6E; male forebasitarsus as in Fig. 6F *F. fasciata* Whitehead & Eardley, 2003
 - Vestiture on female metasoma mostly yellowish, sometimes posterior region of T2–T4 white, and male completely white; female hind tibia yellowish dorsally 11

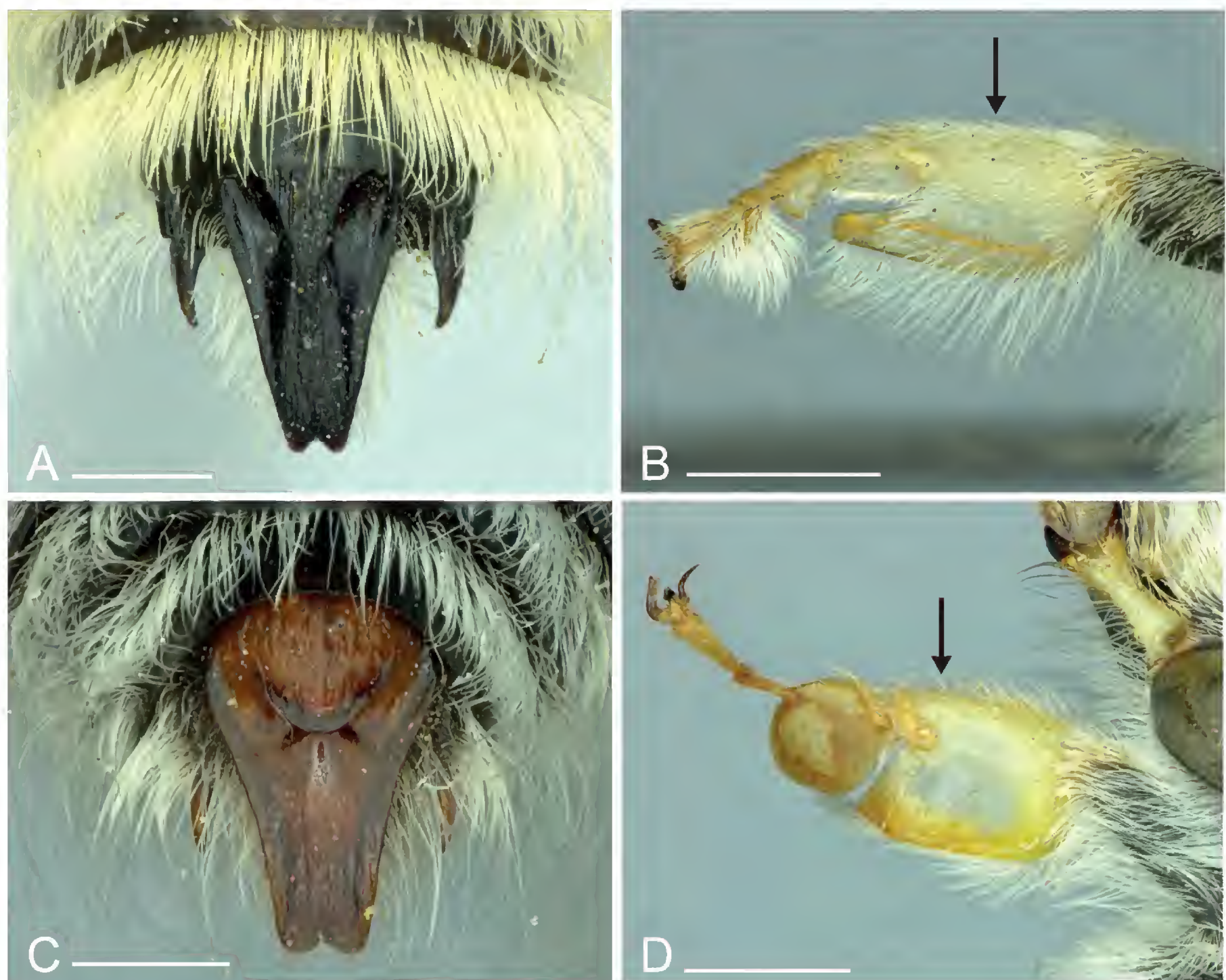


Fig. 7. *Fidelia* spp., ♂♂. **A–B.** *Fidelia ornata* (Cockerell, 1932). **A.** T7. **B.** Forebasitarsus. **C–D.** *F. major* Friese, 1911. **C.** T7. **D.** Forebasitarsus. Scale bars: 1 mm.

11. Female hind basitarsus mostly black; T7 as in Fig. 7A; male forebasitarsus as in Fig. 7B
..... *F. ornata* (Cockerell, 1932)
– Female hind basitarsus orangish above (orange or black below); T7 not as depicted in Fig. 7A; male
forebasitarsus different 12
12. Female hind basitarsus orange below; T7 as in Fig. 7C; male forebasitarsus as in Fig. 7D
..... *F. major* Friese, 1911
– Female hind basitarsus black below; T7 resembles that in Fig. 6E; male forebasitarsus moderately
expanded (width 0.4× length) *F. borearipa* Whitehead & Eardley, 2003

Discussion

According to the criteria outlined by Engel (2004), *Fidelia whiteheadi* Litman & Kuhlmann sp. nov. clearly belongs to the subgenus *Fideliopsis*: the mandible of both male and female are bifid, with the teeth long, slender and divergent and the medioapical process of the male T7 shallowly emarginate at the apex. Within *Fideliopsis*, *F. whiteheadi* Litman & Kuhlmann sp. nov. is most similar to *F. hessei*; both exhibit a yellow to pale yellow female pygidial plate, unmodified male protarsi, short apicolateral processes of the male S7 that taper from a broad base and whose lengths do not surpass the width of the central disc and an absence of paraspiculae on the male S8 (Whitehead & Eardley 2003; Engel 2004). *F. whiteheadi* Litman & Kuhlmann sp. nov. can be distinguished from *F. hessei*, however, by its smaller size, shorter pilosity (Fig. 1A–B), the nature of the pilosity on the female forebasitarsus (Fig. 1C–D), the shape of the apex of the female pygidial plate (Fig. 1E–F), the elevation of the protuberance at the base of the male T7 (Fig. 2A–B), the elevation and width of the protuberance on male S2 (Fig. 2C–D), and, most notably, the shape of the male S7, S8 and gonostylus. (Fig. 3A–F).

Fidelia hessei appears to have a single period of activity each year, in the spring months (September–November) of the winter rainfall areas of the Western and Northern Cape provinces of South Africa (Fig. 4). *Fidelia whiteheadi* Litman & Kuhlmann sp. nov., on the other hand, appears to have two periods of activity a year, one in the spring months (September–November) of the winter rainfall areas of the Northern Cape Province and southwestern Namibia and the second in the autumn months (February–May) of the summer rainfall areas of the Northern Cape Province and the south central and southeastern regions of Namibia (Fig. 4). A few isolated specimens from spring-emerging *F. whiteheadi* Litman & Kuhlmann sp. nov. were found in localities more typical of autumn-emerging *F. whiteheadi* Litman & Kuhlmann sp. nov. (Fig. 4). The distribution of *F. hessei* and that of spring-emerging *F. whiteheadi* Litman & Kuhlmann sp. nov. are sympatric through a portion of their distributions, in the Northern Cape Province of South Africa near the Namibian border.

A handful of specimens exhibit morphological characters intermediate between the two species. Curiously, these specimens are not found in the region of sympatry between the two species but rather in the region of the Klinghardt Mountains, at the northern extreme of the distribution of spring-emerging *F. whiteheadi* Litman & Kuhlmann sp. nov., where few, if any, *F. hessei* occur (Fig. 4). All examined females from this region appear to be *F. whiteheadi* Litman & Kuhlmann sp. nov. Based on specimen size, overall pilosity, the shape of the protuberance on S2, and the shape of the pygidial plate, males also appear to be *F. whiteheadi* Litman & Kuhlmann sp. nov.; an examination of male S7 and S8, however, strongly suggests *F. hessei* in some specimens. It is not clear whether these specimens are simply small, atypical *F. hessei* or *F. whiteheadi* Litman & Kuhlmann sp. nov. with unusual hidden sterna. If these specimens are indeed *F. hessei*, the geographic distribution of this species would extend well into the winter rainfall area of southwestern Namibia (Fig. 4). While some specimens were identified as *F. whiteheadi* Litman & Kuhlmann sp. nov. and others as *F. hessei*, these determinations are provisional; the use of genetic data will be an important element for the identification of these specimens in the future.

According to Whitehead & Eardley (2003), plant visitation records for *F. whiteheadi* Litman & Kuhlmann sp. nov. and *F. hessei* include *Grielum grandillorum* [*sic*; we interpret this as *Grielum grandiflorum*], *Grielum sinuatum*, *Grielum* sp. and *Neuradopsis* sp. In order to determine whether either *F. whiteheadi* Litman & Kuhlmann sp. nov. or *F. hessei* demonstrate a particular preference for any of these hosts, pollen slides were prepared using pollen taken from 24 female specimens representing both species. Pollen identification proved more difficult than anticipated and these slides have yet to be fully analyzed. They are deposited at the SAM and we encourage those interested to examine these slides for further clues as to the host plant preferences of *F. whiteheadi* Litman & Kuhlmann sp. nov. and *F. hessei*.

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References

- Brauns H. 1926. V. Nachtrag zu “Friese, Bienen Afrikas”. *Zoologische Jahrbücher* 52: 187–230.
- Engel M.S. 2002. Phylogeny of the bee tribe Fideliini (Hymenoptera: Megachilidae), with the description of a new genus from southern Africa. *African Entomology* 10 (2): 305–313.
- Engel M.S. 2004. Fideliine phylogeny and classification revisited (Hymenoptera: Megachilidae). *Journal of the Kansas Entomological Society* 77 (4): 821–836. <http://dx.doi.org/10.2317/E-23.1>
- Friese H. 1899. Monographie der Bienengattungen *Megacilissa*, *Caupolicana* und *Oxaea*. *Annalen des K.K. Naturhistorischen Hofmuseums* 14: 239–246. Available from <http://biodiversitylibrary.org/page/5406625> [accessed 19 Dec. 2015]
- Litman J.R., Danforth B.N., Eardley C.D. & Praz. C.J. 2011. Why do leafcutter bees cut leaves? New insights into the early evolution of bees. *Proceedings of the Royal Society B* 278: 3593–3600. <http://dx.doi.org/10.1098/rspb.2011.0365>
- Michener C.D. 2000. *The Bees of the World*. The Johns Hopkins University Press, Baltimore.
- Michener C.D. 2007. *The Bees of the World*. 2nd edition. The Johns Hopkins University Press, Baltimore.
- Rozen J.G. 1977. The ethology and systematic relationships of fideliine bees, including a description of the mature larva of *Parafidelia* (Hymenoptera, Apoidea). *American Museum Novitates* 2637: 1–15.
- Warncke K. 1980. *Fidelia*, eine für die Westpaläarktis neue Bienengattung. *Mitteilungen der Münchner Entomologischen Gesellschaft* 70: 89–94. Available from <http://biodiversitylibrary.org/page/28992198> [accessed 19 Dec. 2015]
- Whitehead V.B. & Eardley C.D. 2003. African Fideliini: Genus *Fidelia* Friese (Hymenoptera: Apoidea: Megachilidae: Fideliinae). *Journal of the Kansas Entomological Society* 76: 250–276.

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